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Two Polychaete Species from the Deep-sea Hydrothermal Vent in the Middle Okinawa Trough

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ABSTRACT—Alvinellid and nautiliniellid polychaetes from the deep-sea hydrothermal vents, the Izena Hole and the Iheya Ridge of the middle Okinawa Trough, were studied taxonomically. *Paralvinella hessleri* was newly recorded from the Izena Hole, about 2000 km apart from its type locality of the Mariana Back-Ark Basin. Another species was found in the mantle cavity of an unidentified species of the genus *Calyptogena* from the Iheya Ridge. This nautiliniellid polychaete is very close to *Shinkai sagamiensis*, however it differs from the latter in having very long notopodia instead of short ones. The description of this new species, *Shinkai longipedata*, was given.

INTRODUCTION

The Izena Hole and the Iheya Ridge of the middle Okinawa Trough, northwest of the Okinawa Island, are now recognized as the active hydrothermal vents on the basis of several geological surveys using the deep-sea submersible "Shinkai 2000" and other research vessels [1, 2]. These geologists also reported the presence of dense communities consisting of bivalves, alvinellid polychaetes, crustaceans, and bacterial mats. Among these organisms, two species of polychaete worms were provided for our taxonomical study. The alvinellid species with white membranous tubes colonizing around sulfide chimneys is identified with *Paralvinella hessleri* which was originally described from the Mariana Back-Ark Basin by Desbruyères and Laubier [3]. The new record of this species from the Izena Hole with a brief taxonomical note is given in this study. A nautiliniellid species was found living commensally in the mantle cavity of an unidentified deep-sea clam of the genus *Calyptogena*. This species is described in the present study as a new species of the genus *Shinkai* Miura and Laubier, 1990 [4].

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The types are deposited in the National Science Museum, Tokyo (NSMT), the Muséum National d'Histoire Naturelle, Paris (MNHN), the National Museum of Natural History, Smithsonian Institution (USNM), and the Japan Marine Science and Technology Center (JAMSTEC).

Family Alvinellidae Desbruyères and Laubier, 1986 (Japanese name: Eragokai-ka, new)
Genus *Paralvinella* Desbruyères and Laubier, 1982 (Japanese name: Itoeragokai-zoku, new)
Paralvinella hessleri Desbruyères and Laubier, 1989
(Japanese name: Mariana-itoeragokai, new)
(Fig. 1, a-f and Table 1)

Paralvinella hessleri Desbruyères and Laubier, 1989, pp. 761-767, Figs. 1-4.

New Record: Izena Hole, Middle Okinawa Trough, DSRV *Shinkai 2000* Dive 360, Sep. 1988, 27°16.0′N, 127°05.0′E, 1430 m 2 specimens; Dive 364, Sep. 1988, 1340 m, 27 specimens; Dive 411, June 1989, 1410 m, 12 specimens.

Largest specimen (Dive 411 No. 1) from Okinawa Trough, 28 mm long excluding branchiae, 4.0 mm wide including parapodia, with 52 setigers (Table 1).

First two achaetous segments fused to following

Table 1. Measurements of specimens from Izena Hole, in *Paralvinella hessleri* Desbruyères and Laubier, 1989

		BW (mm)	BL (mm)	SET	1st U
Dive	1	3.4	17.6	53	19L, 19R
360	2	2.9	12.1	48	18L, 18R
Dive	1	2.3	15.8	53	18L, 18R
364	2	2.7	13.5	53	18L, 19R
	3	2.4	16.0	73	19L, 20R
	4	1.8	13.4	66	22L, 21R
	5	2.0	9.8	49	18L, 19R
	6	2.1	11.5	52	18L, 18R
	7	1.0	6.3	48	18L, 18R
	8	0.9	3.4	42	17L, 17R
	9	0.9	3.5	35	17L, 18R
	10	0.7	2.9	37	19L, 18R
	11	0.7	2.6	36	17L, 17R
	12	0.6	2.6	32	15L, 16R
	13	0.6	2.0	31	15L, 15R
	14	0.5	2.2	33	17L, 18R
	15	0.5	1.8	31	14L, 14R
	16	0.5	1.7	30	16L, 17R
	17	2.9	16.6	53	20L, 18R
	18	3.1	16.8	53	19L, 18R
	19	2.4	10.5	52	18L, 18R
	20	2.5	11.1	53	18L, 18R
	21	2.3	11.5	53	18L, 18R
	22	2.6	13.1	52	18L, 19R
	23	2.6	14.2	51	18L, 18R
	24	2.7	14.4	53	18L, 17R
	25	1.5	5.2	48	19L, 18R
	26	1.5	6.6	44	17L, 18R
	27	0.6	1.6	32	18L, 18R
Dive	1	4.0	28.0	52	19L, 19R
411	2	2.6	16.7	54	19L, 19R
	3	2.3	17.0	49	18L, 18R
	4	3.0	22.0	53	18L, 18R
	5	3.1	27.0	52	17L, 17R
	6	3.6	21.3	53	18L, 18R
	7	3.1	26.3	52	18L, 18R
	8	2.4	18.5	49	18L, 18R
	9	2.6	21.9	51	17L, 17R
	10	3.1	18.7	52	19L, 19R
	11	1.9	11.3	50+	19L, 19R
	12	1.3	10.2	48	19L, 19R

BW: Body width including parapodia at widest part; BL: Body length excluding branchiae; SET: Number of setigers; 1st U: First occurrence of uncini represented by setiger number and side of body (L: Left; R: Right).

setigers (Fig. 1a-d). First three setigers discernible ventrally, with 4 pairs of branchiae (Fig. 1a). Branchial filaments inserted on two opposite sides of each stem. Setiger 4 with median dorsal expansion (Fig. 1b).

Prostomium with well-developed lateral lobes (Fig. 1c). Buccal apparatus eversible, with ventral globular bulky organ, two lateral pointed tentacles and many grooved tentacles (Fig. 1d).

First 13–20 setigers without neuropodial tori. Notopodia small, elevated dorsally on setigers 1–3 (Fig. 1e); cylindrical on setigers 4–6; short, wide, not cylindrical on setiger 7 (Fig. 1c). Setiger 8 modified, with cylindrical notopodia and large, digitiform, dorsal lobes directed forward. Following setigers with cylindrical notopodia and small, digitiform, dorsal lobes (Fig. 1f). Uncinigerous neuropodial tori first present on setigers 14-21 (Table 1).

Notopodial setae simple, capillary, except on setiger 8 with 4–5 very stout hooks directed posteriorly. Uncini bidentate, numerous in single rows.

Pygidium rounded, without appendages. Tubes whitish, with fimbriated openings.

Remarks: The genus *Paralvinella* consists of five species and one subspecies from various hydrothermal vents. They are distinctive by the morphological characters, such as, the shape of branchiae, the composition of buccal apparatus, the first occurrence of neuropodial tori [3, 5]. In these characters, the specimens from the Izena Hole are well identical with *Paralvinella hessleri,* however a minor difference is recognized.

The number of setigers in individual specimens is rather stable in the type materials from the Mariana Back-Ark Basin with the range of 52-61 and the majority of paratypes has 58–61 setigers [3]. The sample from the middle Okinawa Trough consists of 27 large specimens of more than 10 mm in length (thought to be adult) and 14 smaller specimens (juvenile). The number of setigers in these adults is ranging from 48 to 73 and the majority (17 of 27) has 52 or 53 setigers (Table 1). Although these less numerous setigers in the adult specimens from the Okinawa Trough are recognized as difference from the original description,

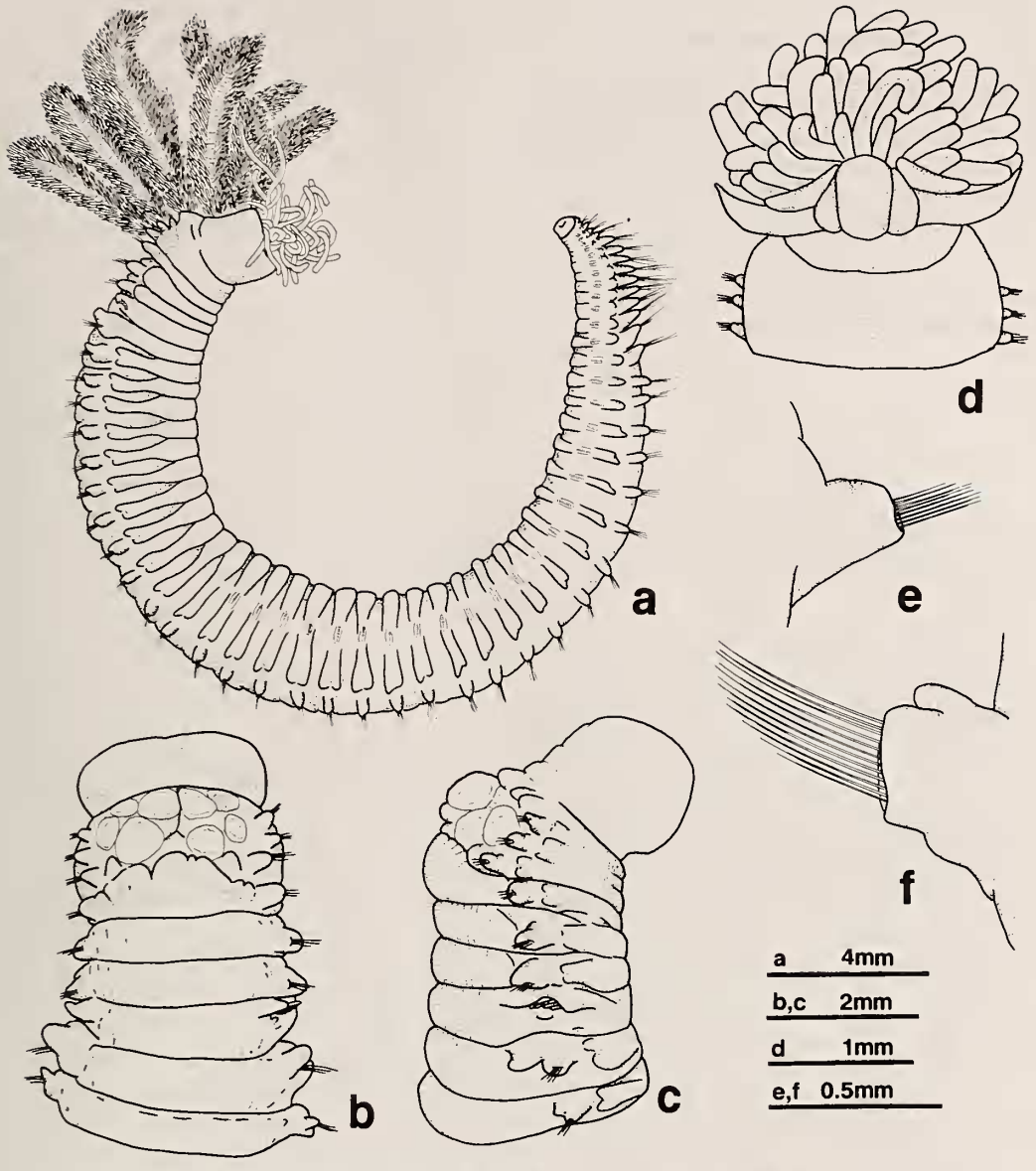


Fig. 1. *Paralvinella hessleri* Desbruyères and Laubier, 1989: a, Whole body (Dive 411 No. 1), lateral view; b, Anterior end of the same, branchiae removed, dorsal view; c, Anterior end of the same, branchiae and buccal tentacles removed, lateral view; d, Buccal apparatus (Dive 364 No. 21), ventral view; e, Parapodium 1 (Dive 411 No. 1). anterior view; f, Notopodium of setiger 20 of the same, anterior view.

we can designate our specimens as *Paralvinella hessleri* by reason of the greately variable number of setigers in both local samples.

Family Nautiliniellidae Miura and Laubier, 1990
(Japanese name: Yadorigokai-ka, new)

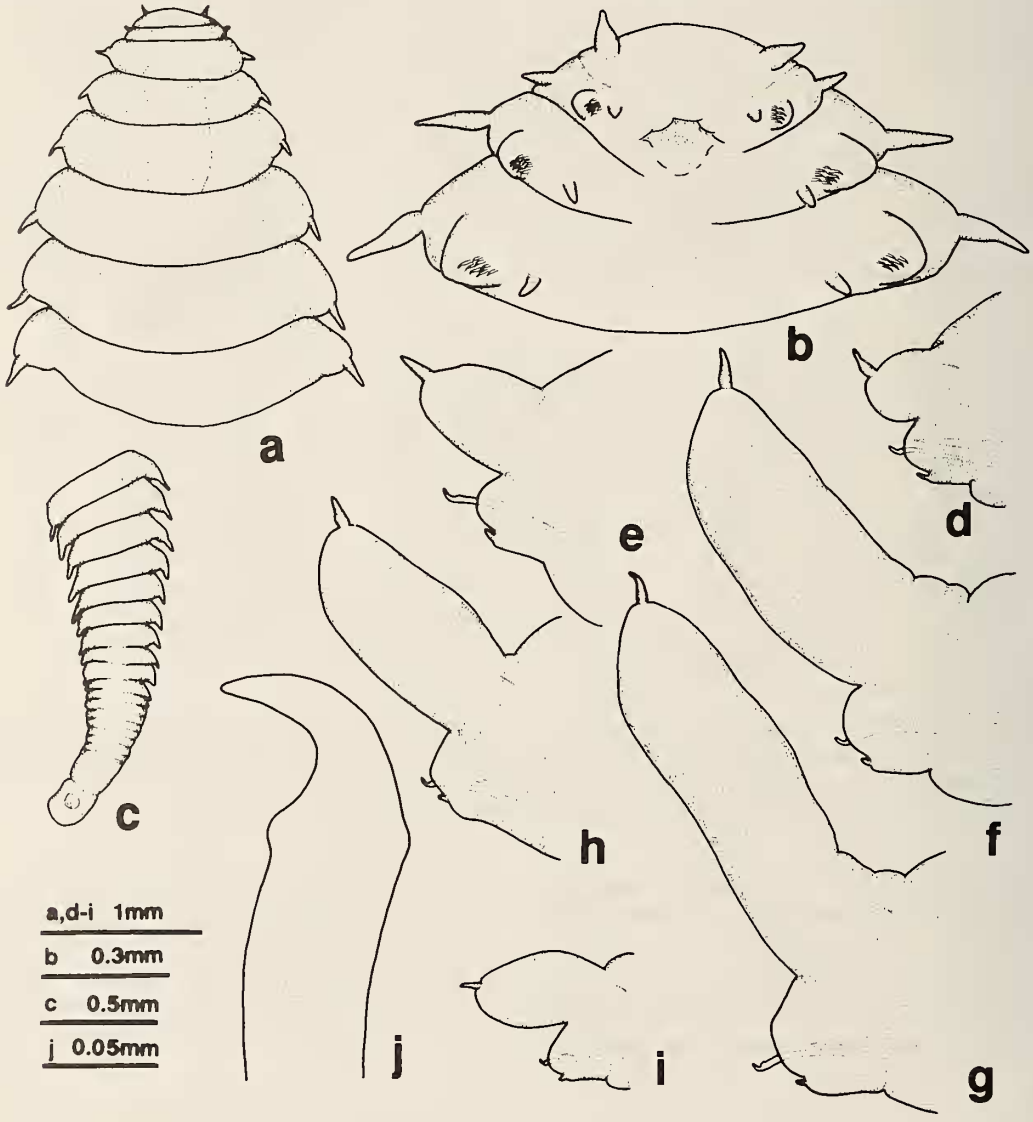
Genus *Shinkai* Miura and Laubier, 1990
(Japanese name: Kagi-yadorigokai-zoku, new)
Shinkai longipedata new species
(Japanese name: Minami-yadorigokai, new)
(Fig. 2, a-j and Table 2)

Materials: Iheya Ridge, Middle Okinawa Trough, DSRV *Shinkai 2000* Dive 409, June 1989, 27°32.7′N, 126°58.2′E, 1400 m, collected from the mantle cavity of *Calyptogena* sp., holotype (NSMT Pol. H-332), 2 paratypes (JAMSTEC), 2 paratypes (MNHN); Dive 410, June 1989, 27°32.5′N, 126°58.5′E, 1395 m, 1 paratype (USNM 131513), 1 specimen (SEM observation)

Measurements: Holotype 114 mm long, 5.5 mm wide including parapodia, with 242 setigers excluding preanal achaetous segments. Largest paratype, ovigerous, 200 mm long, 6.0 mm wide, with 390 setigers (Table 2).

Table 2. Measurements of type specimens in *Shinkai longipedata* sp. n. (Abbreviation as in Table 1)

	BW (mm)	BL (mm)	SET	Deposition, etc.
Dive 409				
1–1	5.5	144	242+	NSMT (Holotype)
–2	6.0	200	390	JAMSTEC (ovigerous)
–3	2.8	95	240	JAMSTEC
2–1	2.3	45	136	MNHN
3–1	5.2	160	350	MNHN
Dive 410				
1	2.1	35	160	USNM
2	2.6	17+20	53+79	(SEM observation)



Description: Body long, flattened ventrally, strongly arched dorsally, with longitudinal ventral groove. Integument smooth. Coloration in alcohol light greenish brown; parapodia darker than trunk (small paraytpes pale or colorless).

Prostomium short, with pair of small cirriform antennae (Fig. 2a, b). Achaetous peristomial ring absent. Setiger 1 ventrally fused with prostomium (Fig. 2b). Foregut with well-developed muscular part (Fig. 2a).

Several achaetous growing segments present in preanal region. Pygidium rounded, without anal cirri (Fig. 2c).

Parapodia subbiramous throughout body (Fig. 2d-i). Notopodia supported by very thin short notoacicula, less-developed on anterior setigers (Fig. 2d, e); long, club-shaped on setigers 50–150 (Fig. 2f, g); shortened again on succeeding setigers (Fig. 2h, i). Dorsal cirri short, situated on distal end of notopodia. Neuropodia short, rounded, supported by very stout acicula. Ventral cirri very short, less than half length of dorsal cirri.

Ventral hook simple, stout, strongly curved on distal end, with low basal knob (Fig. 2j). Each parapodium with 2-10 hooks on anterior 7 setigers (Fig. 2b); with a single hook on succeeding setigers (Fig. 2d-i).

Etymology: The species name, *longipedata,* is derived from the elongated notopodia of the species.

Remarks: In the family Nautiliniellidae, all previously known species are associated with various bivalve mollusks living at cold-seeps or tectonically inactive bottoms [4, 6, 7]. *Shinkai longipedata* is, however, the first nautiliniellid species found at the hydrothermal vent area. Their main diagnostic characters are the number of prostomial antennae, the occurrence of bifurcate setae, and the shape of hooks. The new species is very close to the only other congeneric species, *S. sagamiensis* Miura and Laubier, 1990, in these morphological characters. However, the shape of parapodia is distinctive in these two species. In *S. longipedata,* the notopodia of middle body region are remarkably elongated, but not modified in *S. sagamiensis.*

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FIG. 2. *Shinkai longipedata* sp. n. (holotype): a, Anterior end, dorsal view; b, Anterior end, ventral view; c, Posterior end, dorsal view; d, Parapodium 10, anterior view; e, Parapodium 20; f, Parapodium 50; g, Parapodium 100; h, Parapodium 160; i, Parapodium 200; j, Hook of setiger 60.